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AFTER FINAL REPLY

I. INTRODUCTION

This is in response to the Final Office Action mailed June 5, 2008 in regard to the above-identified patent application. Reconsideration of the rejection of the claims is respectfully solicited in light of the following remarks.

II. CLAIMS

1-18. (Cancelled).

19. (Previously Presented) A method for net shaping gear teeth of a high performance power transmission gear from a powder metal workpiece, comprising the steps of:

(a) heating a powder metal workpiece in the form of a near net shaped gear blank having gear teeth surfaces above its critical temperature to obtain an austenitic structure throughout its surfaces;

(b) isothermally quenching the workpiece at a rate greater than the critical cooling rate of its surfaces to a uniform metastable austenitic temperature just above the martensitic transformation temperature;

(c) rolling the gear teeth surfaces of the workpiece to a substantially finished outer peripheral profiled shape between opposed dies, each die having an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling, while holding the workpiece at the uniform metastable austenitic temperature, the gear teeth surfaces undergoing densification, plastic deformation, strengthening and final shaping as a result of the rolling operation; and

(d) cooling the workpiece through the martensitic range to thereby harden the surfaces of the gear teeth.

20. (Previously Presented) The method set forth in claim 19 wherein step (c) includes the steps, sequentially, of:

(e) radially compacting the material in the gear teeth surface layers resulting in a collapse of the pores initially existing in the gear teeth surface regions with resulting densification of the gear teeth surface regions; and

(f) plastically deforming the gear teeth surface layers by causing lateral material flow of the gear teeth surface layers as a result of the operation of rolling in the metastable austenitic temperature range.

21. (Cancelled).

22. (Previously Presented) The method set forth in claim 19, including the steps, before step (a) of sequentially:

(e) pressing the workpiece;

(f) sintering the workpiece; and

(g) densifying the workpiece.

23. (Previously Presented) The method set forth in claim 27 wherein step (e) includes the steps, alternatively, of:

(h) single pressing the workpiece; and

multiple pressing the workpiece.

24. (Previously Presented) The method set forth in claim 27 wherein step (f) includes the steps, alternatively, of:

(h) single sintering the workpiece; and

(i) multiple sintering the workpiece.

25. (Previously Presented) The method set forth in claim 27 wherein step (f) includes the step of:

(g) sintering and hardening the workpiece in an integrated operation.

26. (Previously Presented) The method set forth in claim 27 wherein step (f) includes the step of:

(g) sintering, hardening, and carburizing the workpiece in an integrated operation.

27. (Previously Presented) The method set forth in claim 19 including the steps, before step (a) of:

(e) pressing the workpiece; and

(f) sintering the workpiece.

28. (Previously Presented) The method set forth in claim 27 including the step of:

(g) applying densifying pressure to surfaces of at least the gear tooth root and gear tooth flank regions of the pressed and sintered powder metal gear blank to establish densification in the range of 90 to 100 percent of full theoretical density to a depth of about 70 microns and up to about 1300 microns.

29. (Previously Presented) The method as set forth in claim 19 for fabricating a parallel axis gear.

30. (Previously Presented) The method as set forth in claim 29 wherein the parallel axis gear includes at least one of a spur gear, a helical gear, and a double helical gear.

31. (Previously Presented) The method as set forth in claim 19 for fabricating an intersecting axis gear.

32. (Previously Presented) The method as set forth in claim 31 wherein the intersecting axis gear includes at least one of a straight bevel gear, a spiral bevel gear, a hypoid gear, a worm gear, and a worm-wheel gear.

33-34. (Cancelled).

35. (Previously Presented) A method of producing net shaped gear teeth from a near net shape workpiece of powder metal having an initial outer peripheral contoured surface, each gear tooth having a gear tooth flank with a nominally involute surface and a root/fillet region with a trochoidal surface, the method comprising the steps of:

(a) rotatably supporting on a first axis a rolling die having an outer peripheral contoured surface extending between generally parallel spaced lateral surfaces transverse to the first axis, the rolling die including a plurality of teeth, each gear tooth including a tooth flank with opposed involute surfaces and a tooth tip surface;

(b) rotatably supporting on a second axis distant from and parallel to the first axis a near net shape powder metal workpiece having an initial outer peripheral contoured surface and including a plurality of gear teeth, each gear tooth having a tooth flank with a nominally involute

surface and a root/fillet region with a trochoidal surface;

(c) advancing the rolling die in an in-feed direction generally perpendicular to the first and second axes such that the rolling die meshingly engages with the workpiece;

(d) rotating the rolling die about the first axis while engaged with the workpiece;

(e) rolling the gear teeth surfaces of the workpiece to a substantially finished outer peripheral profiled shape while engaged with the rolling die having an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling, while holding the workpiece at the uniform metastable austenitic temperature, the gear teeth surfaces undergoing densification, plastic deformation, strengthening and final shaping as a result of the rolling and sliding operation;

(f) while performing step (d), maintaining continuous conjugacy between the rolling die and the workpiece with the involute surface of each tooth of the rolling die engaging the involute surface of a mating tooth of the workpiece and the tooth tip of the rolling die engaging the trochoidal root/fillet surface between adjacent mating gear teeth of the workpiece to effect material flow along the outer peripheral contoured surface;

(g) continuing to advance the rolling die in the in-feed direction thereby deforming the surface of each gear tooth flank and of a corresponding root/fillet region until a

final net shape of each gear tooth and root/fillet region is achieved; and

(h) continuing to perform all of the preceding steps with the rolling die and workpiece meshingly engaged, thereby deforming the involute and trochoidal root/fillet surfaces of all of the gear teeth of the workpiece resulting in a final net shaped gear.

36. (Cancelled).

37. (Previously Presented) The method set forth in claim 35 wherein step (e) includes the steps of:

(i) radially compacting the material in the gear teeth surface layers resulting in a collapse of the pores initially existing in the gear teeth surface regions with resulting densification of the gear teeth surface regions; and

(j) plastically deforming the gear teeth surface layers by causing lateral material flow of the gear teeth surface layers as a result of the operation of rolling and sliding in the metastable austenitic temperature range.

38. (Original) A method as set forth in claim 35 including the step, before step (c) of:

(i) advancing the workpiece in a through-feed direction parallel to the first and second axes such that the outer peripheral profiled surface of the workpiece engages the outer peripheral profiled surface of the rolling die and continues to advance until the workpiece is positioned

substantially coextensive with the rolling die in the through-feed direction.

39. (Original) A method as set forth in claim 38 wherein step (c) includes the steps of:

(i) simultaneously with step (g) after the workpiece and rolling die are substantially enmeshed, advancing the rolling die within a plane containing the first and second axes, in an in-feed direction substantially perpendicular to the first and second axes until the outer peripheral surface of the rolling die engages the outer peripheral surface of the workpiece at a near net shaped center distance establishing an initial center distance between the first and second axes when the workpiece and the rolling gear die are initially engaged; and

(j) continuing to advance the workpiece in the in-feed direction by an additional increment of center distance thereby deforming the profile surfaces of each gear tooth resulting in final net shape of the teeth.

40. (Cancelled).

41. (Previously Presented) A method of producing a full form net shaped gear from a near net shape powder metal workpiece having an initial outer peripheral contoured surface and including a plurality of gear teeth, each gear tooth having a gear tooth flank with a nominally involute surface and a root/fillet region with a trochoidal surface, the method comprising the steps of:

(a) providing a cylindrical grinding wheel having an outer peripheral surface and rotatable about an axis;

(b) dressing the grinding wheel by advancing a dressing tool into engagement with the outer peripheral surface to remove material therefrom to thereby produce a grinding wheel profile having a desired contoured outer surface;

(c) supporting on an axis which lies in a plane parallel to the plane of the grinding wheel axis but perpendicular to the grinding wheel axis a cylindrical rolling die blank having a plurality of circumferentially spaced near net shaped teeth defining an arcuate pitch length between adjacent teeth, each pair of adjacent teeth having opposed gear tooth surfaces and a common root/fillet region therebetween;

(d) advancing the grinding wheel radially toward and into engagement with the rolling die blank such that the contoured outer surface thereof engages the opposed gear tooth surfaces and the common root/fillet region between two adjacent teeth of the rolling die blank;

(e) simultaneously with step (d), rotating the grinding wheel about its axis to produce a final gear tooth profile for the opposed gear tooth surfaces and its common root/fillet region;

(f) withdrawing the grinding wheel from engagement with the rolling die blank;

(g) rotating the rolling die blank on its axis by an increment equal in arc length to the pitch between adjacent teeth thereof so that the grinding wheel is aligned with the opposed gear tooth surfaces and common root/fillet region of the next successive pair of adjacent teeth of the rolling die blank;

(h) repeating steps (d), (e), (f), and (g) until all of the teeth of the rolling die blank have been ground to the desired shape and resulting in a finished rolling die;

(i) rotatably supporting the finished rolling die on a first axis, the rolling die having an outer peripheral contoured surface extending between generally parallel spaced lateral surfaces transverse to the first axis, the rolling die including a plurality of teeth, each including a gear tooth flank with opposed involute surfaces and a gear tooth tip surface;

(j) rotatably supporting the powder metal workpiece on a second axis distant from and parallel to the first axis;

(k) advancing the rolling die in an in-feed direction generally perpendicular to the first and second axes such that the rolling die meshingly engages with the workpiece,

(l) rotating the rolling die while engaged with the workpiece;

(m) rolling the gear teeth surfaces of the workpiece to a substantially finished outer peripheral profiled shape while engaged with the rolling die having an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling, while holding the workpiece at the uniform metastable austenitic temperature, the gear teeth surfaces undergoing densification, plastic deformation, strengthening, and final shaping as a result of the rolling and sliding operation;

(n) while performing step (l), maintaining continuous conjugacy between the rolling die and the workpiece with the involute surface of each tooth of the rolling die engaging the involute surface of a mating tooth of the workpiece and the tooth tip of the rolling die engaging the trochoidal root/fillet surface of a mating tooth of the workpiece; and

(o) continuing to advance the rolling die in the in-feed direction thereby deforming the surface of each gear tooth flank and of a corresponding root/fillet region until a final net shape of each gear tooth and of each root/fillet region is achieved, and

(p) continuing to perform steps (i), (j), (k), (l), (m), and (n) with the rolling die and workpiece meshingly engaged, thereby deforming the involute and trochoidal root/fillet surfaces of each tooth of the workpiece resulting in a final net shape of all of the teeth thereof.

42. (Original) The process set forth in claim 41 wherein step (e) includes the steps of:

(q) radially compacting the material in the gear teeth surface layers resulting in a collapse of the pores initially existing in the gear teeth surface regions with resulting densification of the gear teeth surface regions; and

(r) plastically deforming the gear teeth surface layers by causing lateral material flow of the gear teeth surface layers as a result of the operation of rolling in the metastable austenitic temperature range.

43. (Previously Presented) A method of producing a full form net shaped gear from a near net shape powder metal workpiece having an initial outer peripheral contoured surface and including a plurality of teeth, each having a tooth flank with a nominally involute surface and a root/fillet region with a trochoidal surface, the method comprising the steps of:

(a) rotatably supporting on first and second generally parallel spaced axes, first and second rolling dies, each having an outer peripheral contoured surface extending between generally parallel spaced lateral surfaces transverse to the first axis, each rolling die including a plurality of teeth, each tooth including a tooth flank with opposed involute surfaces and a tooth tip surface;

(b) rotatably supporting the powder metal workpiece on a third axis distant from and parallel to the first and second axes;

(c) advancing the first and second rolling dies, within a common plane generally containing the first, second, and third axes in respectively opposite in-feed directions generally perpendicular to the third axis until the rolling die meshingly engages with the workpiece,

(d) rotating the rolling dies about their associated first and second axes while engaged with the workpiece;

(e) rolling the gear teeth surfaces of the workpiece to a substantially finished outer peripheral profiled shape while engaged with the rolling die having an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling, while holding the

workpiece at the uniform metastable austenitic temperature, the gear teeth surfaces undergoing densification, plastic deformation, strengthening and final shaping as a result of the rolling and sliding operation;

(f) while performing step (d), maintaining continuous conjugacy between each of the rolling dies and the workpiece with the involute surface of each tooth of each of the rolling dies engaging the involute surface of a mating tooth of the workpiece and the tooth tip of each of the rolling dies engaging the trochoidal root/fillet surface between adjacent mating teeth of the workpiece;

(g) continuing to advance each of the rolling dies in the in-feed direction thereby deforming the surface of each tooth flank and of a corresponding root/fillet region until a final net shape of each tooth and of each root/fillet region is achieved, and

(h) continuing to perform all of the preceding steps with the rolling dies and workpiece meshingly engaged, thereby deforming the involute and trochoidal root/fillet surfaces of all of the teeth of the workpiece resulting in a final net shaped machine element.

44. (Previously Presented) The method set forth in claim 43 wherein step (e) includes the steps of:

(i) radially compacting the material in the gear teeth surface layers resulting in a collapse of the pores initially existing in the gear teeth surface regions with resulting densification of the gear teeth surface regions; and

(j) plastically deforming the gear teeth surface layers by causing lateral material flow of the gear teeth surface layers as a result of the operation of rolling and sliding in the metastable austenitic temperature range.

45. (Original) A method as set forth in claim 43 including the step, before step (c) of:

(i) advancing the workpiece in a through-feed direction parallel to the first, second, and third axes such that the outer peripheral profiled surface of the workpiece engages the outer peripheral profiled surface of each of the rolling dies and continues to advance until the workpiece is positioned substantially coextensive with the rolling dies in the through-feed direction.

46. (Original) A method as set forth in claim 44 wherein step (c) includes the steps of:

(i) simultaneously with step (h) after the workpiece and rolling die are substantially enmeshed, advancing the rolling die within a plane containing the first and second axes, in an in-feed direction substantially perpendicular to the first and second axes until the outer peripheral surface of the rolling die engages the outer peripheral surface of the workpiece at a near net shaped center distance establishing an initial center distance between the first and second axes when the workpiece and the rolling gear die are initially engaged; and

(j) continuing to advance the workpiece in the in-feed direction by an additional increment of center distance thereby deforming the profile surfaces of each gear tooth resulting in final net shape of the teeth.

47. (Previously Presented) The method set forth in claim 19 wherein the root/fillet region of the gear teeth are compacted with a rolling die having a tip radius from about 0.014 to about 0.018 inches.

III. REMARKS

1. Claims 19, 20, 22-32, 35, 37-39 and 41-47 are pending.

2. Claims 19-20, 22-24, 27-30 and 47 are patentable under 35 U.S.C. 103(a) over Amateau and Ladousse et al. (US 6729171, hereinafter "Ladousse"). Claim 19 recites that each die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. This feature is not disclosed or suggested by the combination of Amateau and Ladousse.

Amateau discloses something different than what is claimed by Applicant. Amateau discloses that each rolling gear die (44, 46) has an outer peripheral profiled surface for rolling the gear teeth surfaces of the workpiece (42) to a desired outer peripheral profiled shape (Col. 12, L. 64 - Col. 13, L. 2).

The Examiner acknowledges that Amateau does not disclose dies that have a powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling as recited in the claims. Combining Amateau with Ladousse does not remedy the above noted deficiency.

The Examiner asserts that Ladousse discloses dies with a powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling at columns 1-3 and 11-12.

The Examiner states that columns 11-12 of Ladousse teaches the method of Ladousse may be used to size or finish the gear shape, thus meeting the limitation of each die having an outer peripheral powder metal gear tooth finishing surface configured

to geometrically finish the powder metal surface of each tooth during rolling. Ladousse does not disclose these features as the Examiner claims. It is submitted that the Examiner is not considering the reference in its entirety but is rather applying only parts of the reference out of context (see MPEP § 2141.02; A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)). If viewed in its entirety it is evident that Ladousse teaches away from what is recited in Applicant's claims. Column 11, lines 18-22 of Ladousse recites that in a final phase 86 of operation (b), the load is then controlled (F) for one or more successive phases, so that its change continues to observe a predefined cycle, until a final relative position (Xb) of the tools and the part is reached which tallies with the final dimensions of the part "for this stage of manufacture." However, the final dimensions of the part recited at column 11, lines 18-22 of Ladousse are not finished dimensions as called for in Applicant's claims. The final dimensions of the part in Ladousse are in process dimensions that require further processing steps. This is evidenced by column 6, lines 60-65 of Ladousse which recites that the part in its entirety should withstand the total force that the tools impart on it, until a final part is obtained that meets the desired geometric and structural criteria for this stage of its manufacture. Additional evidence in Ladousse that further processing of the part is required can be found in the flow chart in Figure 8 of Ladousse which clearly shows additional processing of the part after step (86) in the flow chart (i.e. the step which "tallies the final dimensions of the part"). As can be seen in Ladousse at least one additional operation is performed on the part in step (88) (i.e. the final sizing phase).

However, final sizing phase described at column 11, lines 47-59 of Ladousse does nothing more than use position control to obtain a part that meets the roundness criteria defined by the user. This roundness criteria is not defined in Ladousse and cannot reasonably be considered to disclose rolling the gear teeth surfaces of the workpiece to a substantially finished outer peripheral profiled shape for geometrically finishing the powder metal surface of each tooth as recited in Applicant's claims. All that can be discerned from Ladousse is that all points on some undefined circumference of the part are equidistant from the center of the part and nothing more. There is absolutely no disclosure in Ladousse of finishing a gear tooth profile as claimed by Applicant. Thus, it is evident from the disclosure in Ladousse that gears formed by the process of Ladousse have subsequent finishing steps to obtain a "geometrically finished" tooth as recited by Applicant.

Ladousse discloses nothing more than the blank adopting a shape conjugate of the tool or tools and nothing more (Col. 6, L. 51-53). Nowhere does Ladousse disclose or suggest dies that have a powder metal gear tooth finishing surface configured to geometrically **finish** the powder metal surface of each tooth during rolling. Nothing in Ladousse discloses or suggests that the "shape conjugate of the tool or tools" results in a geometrically finished (i.e. no further shaping is needed) gear tooth. Rather, Ladousse specifically refers to finishing for "this stage of manufacture". The only "final sizing" disclosed in Ladousse concerns only the roundness of the part and nothing more.

Thus, it is evident that, when read as a whole, the gears of Ladousse are subject to subsequent heat treatment and grinding

processes to achieve the "finished" shape of the gear. Which is not what is recited in Applicants claims.

Therefore, claim 19 is patentable over the combination of Amateau and Ladousse because neither reference, alone or in combination, discloses or suggests that each die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. Claims 20, 22-24, 27-30 and 47 are patentable over the combination of Amateau and Ladousse at least by reason of their respective dependencies.

The Examiner also asserts in the Office Action that the data presented in Applicant's declarations under 37 CFR 1.132 filed on March 4, 2008 and December 21, 207 is insufficient to overcome the rejection of the claims based on Amateau because the data is not a comparison between the instant invention and the closest prior art. It is submitted that Applicant has properly compared the instant invention with the closest prior art, which is currently manufactured, conventional powdered metal gears (and wrought steel gears as a comparison to show the gears formed by the methods of Applicant's claim have equal or better performance than the conventional wrought steel gears).

The Examiner states that Applicant has not explained why the comparison was made between the gears made by the instant process and gears which were made by a process that does not include ausforming. Applicant has on numerous occasions (i.e. during the Examiner interview held on February 27, 2008 and in Applicant's prior responses) explained that the object of the instant patent application is to improve the performance of conventional powder metal gears so that they are substantially equal to that of conventional wrought steel gears (See e.g. Applicant's

Declaration filed on March 4, 2008 and in particular items 2 and 8). Moreover, a powdered metal gear forming process using ausforming simply does not exist in the prior art. Thus, the data provided by Applicant in the prior Declarations properly expresses the unexpectedly improved performance of powder metal gears formed by the instant process over the closest prior art of conventional powder metal gears (and wrought steel gears to which the powdered metal gears are aimed to replace).

Although evidence of unexpected results must compare the claimed invention with the closest prior art, applicant is not required to compare the claimed invention with subject matter that does not exist in the prior art. *In re Geiger*, 815 F.2d 686, 689, 2 USPQ2d 1276, 1279 (Fed. Cir. 1987) (Newman, J., concurring) (Evidence rebutted *prima facie* case by comparing claimed invention with the most relevant prior art. Note that the majority held the Office failed to establish a *prima facie* case of obviousness.); *In re Chapman*, 357 F.2d 418, 148 USPQ 711 (CCPA 1966) (Requiring applicant to compare claimed invention with polymer suggested by the combination of references relied upon in the rejection of the claimed invention under 35 U.S.C. 103 "would be requiring comparison of the results of the invention with the results of the invention." 357 F.2d at 422, 148 USPQ at 714.). As stated above, a process for ausforming powder metal gears (or ausformed powder metal gears themselves) simply does not exist in the prior art.

The Examiner argues that Amateau is the closest prior art because the major difference between Amateau and the instant process is the type of gear blank used in the process and that the major difference between a conventional powdered metal gear and the instant process is the lack of an ausforming and roll finishing

step. This argument is specious at best as it is a gross understatement. Ausforming a powder metal gear is simply not a mere substitution of a powder metal gear blank into the ausforming process of Amateau as this statement by the Examiner implies (see e.g. Applicant's declaration filed on September 10, 2007 and as explained below).

As described in Applicant's prior response a conventional powder metal gear would be the closest prior art. It is respectfully submitted that comparing the unexpected results of the powder metal gear formed by the methods claimed by Applicant with an ausformed wrought steel gear produced by Amateau is an improper comparison especially when the <u>goal of Applicant's research was to achieve a superior powder metal gear having performance characteristics comparable to wrought steel gears</u>, not ausformed wrought steel gears (although it is noted that the performance characteristics of the ausformed powder metal gears are estimated as being comparable to the performance characteristics of the ausformed wrought steel gears). Further, comparing the unexpected results of the gears formed by the methods of Applicant's claims to an ausformed powdered metal gear (as is being suggested by the Examiner through the combination of Amateau and Ladousse and the Examiner's admission that the process of forming a conventional powdered metal gear as in Ladousse lacks an ausforming and roll finishing step) formed by the process in Amateau would be comparing Applicant's invention with Applicant's invention because as noted above, an ausformed powdered metal gear did not exist before Applicant's instant endeavor. Such a combination of Amateau and Ladousse is being made solely on the bases of hindsight and nothing more.

As described in Applicant's prior response, the rolling process of wrought steel gears is performed with dies that are designed to provide a laterally oriented material flow (i.e. tangential material flow up and down the gear teeth and axial material flow). Amateau is silent as to any radial compaction of the gear material (See e.g. items 4 and 6(e) of the September 10, 2007 Declaration and item 9 of the March 4, 2008 Declaration). As stated in Applicant's March 4, 2008 Declaration in item 9, the process of the instant Application plastically deforms and densifies the surface of the powdered metal gear teeth with powdered metal ausforming dies to form a tooth having a finished geometrical shape where no subsequent shaping is needed. This forming process (i.e. plastic deformation and radial compaction) is not disclosed in Amateau and/or Ladousse, nor is the formation of the ausforming powder metal dies obvious based on Amateau and/or Ladousse. The design of the dies used in the instant process is non-trivial and requires in depth analysis so that the proper compaction and plastic deformation is performed on the powdered metal gear during Applicant's claimed process. Such a die design is not obvious to one skilled in the art based on a die that plastically deforms a non-compactable gear material such as wrought steel (or for that matter, only compacts the gear material as in Ladousse).

The die designs of Amateau and Ladousse are designed to perform different operations on the workpiece. For example, as described above, dies to ausform wrought steel gears are designed to plastically deform the surface layers of the gear blank without any volume change of the workpiece. The depth of the surface deformation when ausforming a wrought steel gear is less than about 0.0015 inches per flank (tooth thickness reduction is about 0.003 inches) where the die has to impart high lateral loads (and

be able to withstand substantial elastic deflections of the gear/die teeth) to induce plastic deformation in the tooth surface. A die for forming a powder metal gear such as that disclosed in Ladousse is designed to densify the soft steel surface layers of the powder metal workpiece. No plastic deformation is performed in Ladousse and there are low elastic deflections of gear/die teeth as compared to the dies of Amateau. The tooth thickness reduction in Ladousse (as in the previously cited reference Cole) is up to about 0.010 inches. The die of Ladousse is also only designed for pre-finishing operations prior to heat treating the workpiece as evidenced by the statements in Ladousse (described above) that specifically refer to finishing for "this stage of manufacture" and "final sizing" only relating to the <u>roundness</u> of the part and nothing more (i.e. Ladousse requires subsequent grinding or other finishing finish shaping the gear teeth). The process recited in Applicant's claim calls for a die having a <u>powder metal gear tooth finishing surface</u> for plastically deforming and densifying the surface of the gear teeth to form a tooth having a finished geometrical shape where no subsequent shaping is needed. The combination of Amateau and Ladousse is silent as to this feature of Applicant's claims.

Further, the gears produced by the methods claimed by Applicant have shown unexpected increases in durability over conventional powder metal gears, which are the closest prior art as described above and in Applicant's prior response filed on March 4, 2008, the entirety of which is incorporated herein by reference. Again, it is noted that Applicant conducted <u>research to improve the performance characteristics of powder metal gears</u>. (See item 2, Sonti Declaration dated March 3, 2008, attached hereto; See also MPEP 716.02(c) and <u>In re May</u>, 574 F.2d 1082, 197 USPQ 601 (CCPA 1978) where evidence that the compound was unexpectedly

nonaddictive was sufficient to overcome the obviousness rejection. Although the compound [in In re May] also had the expected result of potent analgesia, there was evidence of record showing that the goal of research in this area was to produce an analgesic compound which was nonaddictive, enhancing the evidentiary value of the showing of nonaddictiveness as an indicia of nonobviousness. It is noted that In re May is analogous to the instant Application as the goal of Applicant's research was to produce a powdered metal gear having better performance properties than conventional powdered metal gears so that powdered metal gears formed by Applicant's process have properties approaching that of conventional wrought steel gears.) It is to this goal that Applicant's claims are directed. Therefore, applicant has compared its unexpected results with a conventional powder metal gear (i.e. that of the previously cited reference Cole) which is equivalent to the powder metal gear of the Ladousse reference (i.e. what Applicant's deems to be the closest relevant prior art)(See MPEP 716.02(e) stating "Applicants may compare the claimed invention with prior art that is more closely related to the invention than the prior art relied upon by the examiner"; In re Holladay, 584 F.2d 384, 199 USPQ 516 (CCPA 1978; and Ex parte Humber, 217 USPQ 265 (Bd. App. 1961)). It is noted that comparison to wrought steel gears is provided in Applicant's Declarations to show that the performance characteristics of the gears formed by the methods claimed are comparable to or unexpectedly exceed the performance characteristics of wrought steel gears.

In addition, as described in item 8 of Applicant's Declaration filed on March 4, 2008, it is stated that the manufacturing cost per piece to produce ausformed powder metal steel gears according to the methods claimed by Applicant was about 43% lower than the

manufacturing cost per piece to produce conventional wrought steel gears of equivalent quality (conventional wrought steel gears were used a comparison because these are the gears the ausformed powder metal gears are aimed to replace). This cost difference, as is readily apparent to one skilled in the art would only be increased if the cost of producing an ausformed powdered metal gear according to Applicant's process were compared with forming an ausformed wrought steel gear with the method of Amateau. Thus, forming a powder metal ausformed gear according to the methods claimed by Applicant shows significant cost savings over a wrought steel gear having equivalent performance characteristics (and even greater cost savings over an ausformed wrought steel gear).

Thus, claims 19, 20, 22-24, 27-30 and 47 are patentable for these additional reasons which describe how the differences between the cited art and Applicant's claims are inconsequential with respect to the inferior qualities of conventional gear forming processes as described in Applicant's Declarations.

4. Claims 25 and 26 are patentable under 35 U.S.C. 103(a) over Amateau, Ladousse and "Applicant's Admitted Prior Art". It is submitted that because Amateau and Ladousse do not disclose or suggest all the features of Applicant's claim 19 (from which claims 25 and 26 depend) that the combination of Amateau, Ladousse and "Applicant's Admitted Prior Art" cannot as well. Thus claims 25 and 26 are patentable at least by reason of their respective dependencies.

5. Claims 31 and 32 are patentable under 35 U.S.C. 103(a) over Amateau, Ladousse and Torii et al. (US 4972735, hereinafter Torii). It is submitted that because Amateau and Ladousse do not disclose or suggest all the features of Applicant's claim 19

(from which claims 31 and 32 depend) that the combination of Amateau, Ladousse and Torii cannot as well. Thus claims 25 and 26 are patentable at least by reason of their respective dependencies.

6. Claims 35, 37-39 and 41-46 are patentable under 35 U.S.C. 103(a) over Sonti et al. (US 6779270, hereinafter "Sonti") and Ladousse. Claim 35 recites that the rolling die has an outer peripheral powder metal gear tooth finishing surface configured to geometrically finish the powder metal surface of each tooth during rolling. This feature is not disclosed or suggested by the combination of Sonti and Ladousse for substantially the same reasons described above with respect to the combination of Amateau and Ladousse.

Sonti discloses something different than what is claimed by Applicant. Sonti discloses that each rolling die has a plurality of teeth (42) and an outer peripheral contoured surface (44) extending between generally parallel spaced lateral surfaces (46, 48) (Col. 4, L. 48-51).

As described above, Ladousse does not disclose the features of claim 35 as the Examiner claims. Again, it appears that the Examiner is not considering the reference in its entirety but is rather applying only parts of the reference out of context (see MPEP § 2141.02). If viewed in its entirety Ladousse teaches away from what is recited in Applicant's claims. Col. 11, L. 18-22 of Ladousse recites that in a final phase 86 of operation (b), the load is then controlled (F) for one or more successive phases, so that its change continues to observe a predefined cycle, until a final relative position (Xb) of the tools and the part is reached which tallies with the final dimensions of the part. However, the "final dimensions of the part" in Ladousse

are not the same as geometrically finishing the powder metal surface of each tooth as claimed by Applicant. This is evidenced by column 6, lines 60-65 of Ladousse which recites that the part in its entirety should withstand the total force that the tools impart on it, until a final part is obtained that meets the desired geometric and structural criteria for this stage of its manufacture. Thus, it is evident from the disclosure in Ladousse that gears formed by the process of Ladousse have subsequent finishing steps to obtain a "geometrically finished" tooth as recited by Applicant. Further, column 11, line 47 describes an optional final sizing phase 88 that does nothing more than use position control to obtain a part which meets the roundness criteria defined by the user.

Ladousse discloses nothing more than the blank adopting a shape conjugate of the tool or tools and nothing more (Col. 6, L. 51-53). Nowhere does Ladousse disclose or suggest dies that have a powder metal gear tooth finishing surface configured to geometrically **finish** the powder metal surface of each tooth during rolling. Nothing in Ladousse discloses or suggests that the "shape conjugate of the tool or tools" results in a geometrically finished (i.e. no further shaping is needed) gear tooth. Rather, Ladousse specifically refers to finishing for "this stage of manufacture". The only "final sizing" disclosed in Ladousse concerns only the roundness of the part and nothing more.

Thus, it is evident that, when read as a whole, the gears of Ladousse are subject to subsequent heat treatment and grinding processes to achieve the "finished" shape of the gear. Which is not what is recited in Applicants claims.

Thus, claim 35 is patentable over the combination of Sonti and Ladousse because neither reference, alone or in combination, discloses or suggests that each die has an outer peripheral <u>powder metal gear tooth finishing surface</u> configured to substantially <u>finish the powder metal surface</u> of each tooth during rolling.

Claim 35 is also patentable over Sonti and Ladousse for the additional reason that the gears of Applicant's claims proved to have unexpected increases in performance and durability as described in Applicant's prior response (previously incorporated by reference).

Claims 41 and 43 are patentable over the combination of Amateau and Ladousse for reasons that are substantially similar to those described above with respect to claim 35. Claims 37-39, 42 and 44-46 are patentable over the combination of Amateau and Ladousse at least by reason of their respective dependencies.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present in the application are clearly novel and patentable over the prior art of record, and are in proper form for allowance. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issues remain, the Examiner is invited to call Applicants' attorney at the telephone number indicated below.

The Commissioner is hereby authorized to charge payment for one additional dependent claim and any fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.

Respectfully submitted,

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